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STATE OF ILLINOIS

ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

GROUNDWATER WITHDRAWALS FROM AQUIFERS IN ILLINOIS WITH EMPHASIS ON PWS WELLS

by
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in Table 15 and on Plate 13. Over 0.68 mgd of ground water is pumped from this aquifer through 73 wells [redacted]

[redacted] the TDS content of water exceeds 10,000 mg/l. This is due to vertical variations in water quality in the Pennsylvanian System. The 10,000 mg/l TDS line on the map shows the approximate maximum areal extent of formation waters containing more than 10,000 mg/l TDS, in the lower part of this System. Relatively less mineralized "fresh water" floats above more mineralized water. Near the margin of deposits in the System, the "fresh water" forms a small wedge beneath the more mineralized water. This is probably due to differences in hydraulic conductivity of the deposits (Brower, 1981, personal communication). [redacted]

Cretaceous-Tertiary: This aquifer is currently limited in use for PWS wells, [redacted] Moderate quantities of water are available from the sand and gravel.

The aquifer is intercepted by only four single aquifer wells [redacted]

Quaternary: The Quaternary aquifers are the most heavily pumped aquifers in Illinois. There are many areas within the State where well yields of 500 gpm or more are common from the sand and gravel deposited within the major valley systems, buried bedrock valleys, and outwash plains. These systems include the Wabash, Ohio, Illinois, Mississippi, and Rock River Valleys, the Buried Mahomet Valley in east-central Illinois, and several buried and surface valley systems in the northern third of the State.

The Quaternary aquifers are open to 1,150 single aquifer wells as opposed to 22 multiple aquifer wells (Table 15). Well yields are from three to 3,000 gpm and well depths from 16 to 438 feet (Table 1). The location of these wells is presented on Plate 12. Over 132.2 mgd of ground water is pumped from these aquifers through 1,052 wells located at 401 Group I PWS facilities (Table 14A). This withdrawal from the Quaternary aquifer is the largest amount from any single aquifer used by Group I PWS facilities in the State.

Self-Supplied Industry

Presently, the number and location of self-supplied industrial wells or individual aquifer(s) utilized by these wells have not been recorded over a statewide basis. Therefore, location and number of wells, and pumpage from each individual aquifer cannot be given at the present time. Primarily, there are three major categories of industries which withdraw ground water in Illinois: manufacturing, mineral extraction, and thermo-electric. Industries outside of these categories are grouped as "other".

Table 1. Quaternary aquifer, public water supply wells (con't)

NON-RESPONSIVE

[redacted]

Table 1. Quaternary aquifer, public water supply wells (con't)

NON-RESPONSIVE

[redacted]

Table 16. Aquifer use and ground water withdrawals for PWS by county in Illinois (con't)

NON-RESPONSIVE

[redacted]

Table 17. Self-supplied industry, ground water withdrawals in million gallons per day (con't)

County	Manufacturing (SIC 2000-3999)	Mineral Extraction (SIC 1000-1499)		Thermoelectric (SIC 4911 & 4931)	Other	Total
		Brine	Fresh			
Jo Daviess	2.658	0.	0.	0.	.064	2.722
Johnson	0.	0.	0.	0.	0.	0.
Kane	3.284	0.	.010	0.	.186	3.470
Kankakee	.323	0.	<.001	0.	0.	.324
Kendall	.860	0.	<.001	0.	.016	.877
Knox	<.001	0.	.003	0.	0.	.003
Lake	2.740	0.	.050	0.	.069	2.859
LaSalle	5.376	0.	.512	.295	0.	6.183
Lawrence	.058	5.055	.008	0.	0.	5.120
Lee	.312	0.	.046	0.	.203	.561
Livingston	.063	0.	0.	0.	0.	.063
Logan	.011	0.	0.	0.	0.	.011
McDonough	.026	0.	.001	0.	0.	.026
McHenry	2.027	0.	.026	0.	.138	2.191
McLean	.500	0.	0.	0.	0.	.500
Macon	<.001	0.	0.	0.	0.	.001
Macoupin	0.	0.	0.	0.	0.	0.
Madison	56.252	.122	.028	0.	0.	56.401
Marion	0.	10.702	0.	0.	0.	10.702
Marshall	.550	0.	0.	0.	0.	.550
Mason	.003	0.	0.	0.	0.	.003
Massac	3.412	0.	0.	.904	0.	4.316
Menard	0.	0.	0.	0.	0.	0.
Mercer	0.	0.	0.	0.	.001	.001
Monroe	0.	0.	0.	0.	0.	0.
Montgomery	0.	0.	.032	0.	0.	.032
Morgan	2.926	0.	0.	.331	0.	3.257
Moultrie	0.	0.	0.	0.	0.	0.
Ogle	1.195	0.	.040	0.	0.	1.235
Peoria	8.742	0.	.003	0.	.043	8.788
Perry	0.	.015	0.	0.	0.	.015
Piatt	2.290	0.	0.	0.	0.	2.290
Pike	0.	0.	0.	0.	.002	.002
Pope	0.	0.	0.	0.	0.	0.
Pulaski	0.	0.	0.	0.	0.	0.
Putnam	0.	0.	0.	0.	0.	0.
Randolph	0.	0.	.014	0.	0.	.014
Richland	0.	.997	.021	0.	0.	1.018
Rock Island	9.154	0.	0.	.047	0.	9.201
St. Clair	3.667	0.	.001	0.	13.214	16.882
Saline	0.	.362	0.	0.	0.	.362
Sangamon	0.	0.	0.	0.	0.	0.

Table 18. Rural domestic, agriculture, and fish and wildlife ground water withdrawals in million gallons per day (con't)

County	Rural domestic		Agriculture			Fish and wildlife
	Pumpage	Aquifers used**	Irrigation	Livestock	Total	
JoDaviess	.885*	Q,S-D,Maq,G-P,G-StP	.120	2.045	2.165	0.
Johnson	.286	Q,Pen,MCh,MVa	0.	.463	.463	0.
Kane	1.932*	Q,S-D,Maq,G-P	.315	.750	1.065	0.
Kankakee	2.106*	Q,S-D,Maq	7.100	.257	7.357	0.
Kendall	1.607*	Q,S-D,Maq,G-P,G-StP	.020	.370	.390	0.
Knox	.371	Q,Pen,MVa,S-D	0.	1.453	1.453	0.
Lake	3.383*	Q,S-D,Maq,G-P	.755	.137	.892	.047
LaSalle	.790*	Q,Pen,G-StP, G-P,PduC	.030	.794	.824	0.
Lawrence	.261	Q,Pen	1.607	.217	1.824	0.
Lee	.720*	Q,Pen,S-D,Maq,G-P	2.531	.748	3.279	0.
Livingston	1.103	Q,Pen,S-D	0.	.807	.807	0.
Logan	.296	Q,Pen	0.	.503	.503	0.
Macon	1.481	Q,Pen	0.	.208	.208	0.
Macoupin	.574	Q,Pen	0.	1.281	1.281	0.
Madison	1.474	Q,Pen,MCh,MVa	.562	.750	1.312	0.
Marion	.100	Q,Pen	0.	.523	.523	0.
Marshall	.369	Q,Pen	.121	.372	.493	0.
Mason	.803	Q,Pen,MVa	29.091	.279	29.370	0.
Massac	.111	Q,K-T,MCh,MVa	.121	.339	.460	1.953
McDonough	.570	Q,Pen,MVa	0.	.818	.818	0.
McHenry	4.169*	Q,S-D	.768	1.056	1.824	.237
McLean	.750	Q,Pen	.040	.775	.815	0.
Menard	.428	Q,Pen	0.	.326	.326	0.
Mercer	.726	Q,Pen,S-D	.221	1.257	1.478	0.
Monroe	.370	Q,MCh,MVa	.281	.372	.653	0.
Montgomery	.540	Q,Pen	.161	.775	.936	0.
Morgan	.357	Q,Pen,MVa	0.	.770	.770	0.
Moultrie	.190	Q,Pen	0.	.223	.223	0.
Ogle	1.819*	Q,G-P,G-StP,PduC	.540	1.705	2.245	0.
Peoria	1.416	Q,Pen,MVa	0.	.507	.507	0.
Perry	.223	Q,Pen	.201	.409	.610	0.
Piatt	.439	Q,Pen	.014	.188	.202	0.
Pike	.564	Q,MVa,S-D	.402	2.128	2.530	0.
Pope	.039	Q,Pen,MCh,MVa	.001	.225	.226	0.
Pulaski	.124	Q,K-T,MVa,S-D	0.	.185	.185	0.
Putnam	.242	Q,Pen,S-D,G-P,G-StP	.181	.170	.351	0.
Randolph	.186	Q,Pen,MCh,MVa	.201	.774	.975	0.
Richland	.280	Q,Pen	0.	.321	.321	0.
Rock Island	1.481*	Q,Pen,S-D	.780	.727	1.507	0.
St.Clair	1.854	Q,Pen,MCh,MVa	.603	.556	1.159	0.
Saline	.179	Q,Pen	0.	.234	.234	0.
Sangamon	2.806	Q,Pen	.040	.766	.806	0.

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HANDBOOK OF Water Resources and Pollution Control

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TABLE 12-28. Mechanical Aeration Plant Data

Plant	Average Flow (mgd)	Aeration Period (hours)	Return Sludge (percent)	SUSPENDED SOLIDS (ppm) Mixed Liquor	Return Sludge	Sludge Index	BOD Loadings (lbs/1000 ft^3)	BOD (ppm) Primary Effluent	Final Effluent	Percent Removal
Bataria, Ill.	0.9	4.6	30	820	1520	56	17.5	70	9	87
Belvidere, Ill.	1.2	7.0	17	560	–	643	20.4	126	5	96
Bryon, Ohio	0.7	9.3	30	710	2040	603	9.2	67	10	85
E. Lansing, Mich.	1.8	4.8	33	1100	2700	53	12.7	40	10	75
Geneva, Ill.	0.9	6.0	14	620	2520	110	34.5	170	11	94
Greece, N.Y.	0.6	8.8	17	1040	4170	173	25.6	170	17	90
Radnor, Pa.	0.8	10.0	40	900	2000	155	11.0	104	7	93

sludge settles to, say 400 ml, then the sludge index will be 200, and the required sludge return would have to be increased to 50 percent to maintain stability in the aerator. As bulking continues, this condition becomes progressively worse until the return sludge and/or sedimentation tank capacities become overtaxed.

The most common cause of sludge bulking is the overloading of the aerators in terms of BOD per pound of mixed liquor solids. Introduction of industrial wastes that have a deleterious effect on biological growth, or insufficient aeration necessary to maintain favorable biological conditions in the aerator can also produce this effect.

To cope with normal load fluctuations of domestic sewage, it is customary to provide return sludge capacity of from 10 to 100 percent of the incoming sewage flow, and blower capacity (or aeration capacity equivalent) equal to 150 to 200 percent of normal requirements. Dissolved oxygen in the aerators should be maintained at a minimum of 2 to 3 mg/l in conventional systems. It should be noted that modified aeration requires only about half of the amount of air as conventional systems, while extended aeration, because of its low loading and oxygen requirements for biological oxidation, requires twice as much. Where bulking is caused by industrial wastes that either overload or poison the system, the only remedies are the elimination of such wastes from the system or the pretreatment of them.

Trickling Filters. Trickling filters are beds of stone, tile, or plastic media coated with a biological growth or film called zooglea. This forms when settled sewage is caused to flow through the bed, either continuously or intermittently. Contact with the zoogleal film after it becomes well-established causes biological oxidation of the sewage solids in much the same way as it is accomplished in the activated sludge process. The liquid discharged from the bed is then normally settled to remove solids sloughed from the bed. This sloughing may be intermittent or continuous.

Sewage was formerly dosed intermittently to the bed via fixed nozzles fed by dosing tanks equipped with automatic siphons. Practically all modern units are now supplied with rotary distributors (Fig. 12-12). In general, there are two types of trickling filters—low-rate or conventional units, and high-rate units.

Low-rate units are generally operated in the range of 25 to 100 gpd/ft^2 and at a BOD loading of 5 to 25 lb/1000 ft^3 of bed volume. Recirculation was not employed in the past, but is now quite common. Filter media depths average 6 ft. On this basis, a 1.0 mgd plant having a BOD of 130 mg/l in the settled sewage would require a filter bed 113 ft in diameter by 6 ft deep. Here the hydraulic loading would be 100 gpd/ft^2 and the BOD loading 18 lb/1000 ft^3. This plant could be expected to produce an effluent averaging 30 to 40 mg/l suspended solids and 20 to 40 mg/l BOD. These would represent monthly averages. Here, as in activated sludge treatment, however, daily and seasonal variations will be considerable, especially in view of the fact that low-rate filters usually slough periodically. High nitrification

The

Condensed Chemical Dictionary

TENTH EDITION

Revised by

GESSNER G. HAWLEY

VAN NOSTRAND REINHOLD COMPANY
NEW YORK CINCINNATI TORONTO LONDON MELBOURNE

CA, CO, DM, RC: A series of alkylphenoxypoly(oxyethylene)ethanols, resulting from the combination of an alkylphenol with ethylene oxide. The general formula is $RC_6H_4O(CH_2CH_2O)_xCH_2CH_2OH$ in which R may be C_8H_{17} or a higher homolog.

LO and A: A series of linear alkylphenol ethoxylates (LO series) and a series of linear aliphatic ethoxylates (A series).

"Igepon."[307] Trademark for a series of anionic surfactants used as detergents, wetting agents, emulsifiers, dispersants and foaming agents. T and C types are sulfo-amides derived from N-methyltaurine or N-cyclohexyltaurine and fatty acids and have the general formula: $RCON(R')CH_2CH_2SO_3Na$. A types are sulfo-esters derived from isethionic acid and a fatty acid and have the general formula: $RCOOCH_2CH_2SO_3Na$. (R and R′ are alkyl groups).

ignition control compound. A substance such as methyl diphenyl phosphate, or trimethyl phosphate which is added to gasoline to control spark plug fouling, surface ignition, and motor rumble.

ignition point. See autoignition point.

ignotine. See carnosine.

"Illium."[491] Trademark for a series of superstainless steel alloys with high corrosion resistance.

ilmenite (titanic iron ore) $FeO \cdot TiO_2$. Iron-black mineral; black to brownish-red streak; submetallic luster. Resembles magnetite in appearance but is readily distinguished by feeble magnetic character. Sp. gr. 4.5–5; Mohs hardness 5–6.

Occurrence: Widely in U.S.; Canada; Sweden; U.S.S.R.; India. Also made synthetically.

Uses: Titanium paints and enamel; source of titanium metal; welding rods; titanium alloys; ceramics.

x **Imhoff tank.** A reinforced concrete structure of considerable size (about 35 ft high) designed especially for sewage clarification. Its principal features are (1) an upper or sedimentation compartment in which in-flowing sewage deposits its suspended solids by gravity (residence time 2 to 3 hours), the free water being drawn off through an outlet; and (2) a separate lower compartment in which digestion of the accumulated sediment (sludge) takes place. The sludge is passed from the upper compartment to the digestion chamber through an inclined slot or channel. The gases generated by digestion are released through suitably located vents. The digested sludge is removed through outlet pipes at intervals of about 6 months. The dried sludge contains 2 to 3% ammonia and 1% phosphoric acid, which make it suitable as a soil conditioner. See also sewage sludge.

imidazole (glyoxalin) HNCHNCHCH. A dinitrogen ring compound. An antimetabolite (q.v.) and inhibitor of histamine. Colorless crystals, m.p. 90° C; b.p. 257° C. Soluble in water, alcohol, and ether. Used in biological control of pests, especially fabric-feeding insects, often in combination with *dl-p*-fluorophenylalanine, an amino-acid inhibitor; also as a contact insecticide in an oil spray. The mechanism is that of structural antagonism rather than active toxicity. See also antihistamine; antagonist, structural.

4,5-imidazoledicarboxamide. See glycarbylamide.

4-imidazole ethylamine. See histamine.

2-imidazolidinone. See ethylene urea.

2-imidazolidone. See ethylene urea.

***imidazo* (4,5-d)pyrimidine.** See purine.

imide. A nitrogen-containing acid having two double bonds. See succinimide; phthalimide.

imine. A nitrogen-containing organic substance having a carbon-to-nitrogen double bond $R-CH{=}NH$. Such compounds are highly reactive, even more so than the carbon-nitrogen triple bond characteristic of nitriles.

3,3′-iminobispropylamine (dipropylene triamine; 3,3′-diaminodipropylamine) $H_2NC_3H_6NHC_3H_6NH_2$.

Properties: Colorless liquid; sp. gr. 0.9307 (20/20° C); b.p. 240.6° C; f.p. −6.1° C; flash point 175° F (79.4° C) (closed cup); soluble in water and polar organic solvents. Combustible.

Hazard: Moderately toxic by ingestion and inhalation; irritant.

Uses: Intermediate for soaps, dyestuffs, rubber chemicals, emulsifying agents, petroleum specialties, insecticides, and pharmaceuticals.

iminodiacetonitrile $HN(CH_2CN)_2$.

Properties: Light tan, crystalline solid; m.p. 77–78° C; soluble in water and acetone.

Hazard: May be toxic.

Use: Chemical intermediate.

iminourea. See guanidine.

"IML-1."[28] Trademark for a creamy-white nondusting powder of sodium alkyl sulfates, used as an internal lubricant in elastomer compounds. Improves flow characteristics but does not appreciably reduce tensile strength.

"Imlar."[28] Trademark for vinyl resin-base finish used where extreme resistance to abnormal chemical exposure is required.

"Immedial."[307] Trademark for a series of sulfur dyestuffs. Used for the dyeing of cotton and rayon. Characterized by very good fastness to light and good fastness to washing and perspiration.

immiscible. Descriptive of substances of the same phase or state of matter that cannot be uniformly mixed or blended. Though usually applied to liquids

x Imhoff tank